

00100100 Example 1

	SI	C1 ABC	C2 ABC	C3 ABC	S0	
PS1		000	000	000		
CP1		010	001	011		Tests: C1 000-010, C2 000-001, C3 000-011 decode
SH1	001001001	→ 001	→ 001	→ 001	→ 010001011	
PS2		001	001	001		
CP2		010	110	010		Tests: C1 001-010, C2 001-110, C3 001-010 decode
SH2	010010010	→ 010	→ 110	→ 010	→ 010110010	
PS3		010	010	010		
CP3		011	011	101		Tests: C1 010-011, C2 010-011, C3 010-101 decode
SH3	011011011	→ 011	→ 011	→ 101	→ 011011101	
PS4		011	011	011		
CP4		110	100	100		Tests: C1 011-110, C2 011-100, C3 011-100 decode
SH4	100100100	→ 100	→ 100	→ 100	→ 110100100	
PS5		100	100	100		
CP5		101	101	101		Tests: C1 100-101, C2 100-101, C3 100-101 decode
SH5	101101101	→ 101	→ 101	→ 101	→ 101101101	
PS6		101	101	111		
CP6		110	110	000		Tests: C1 101-110, C2 101-110, C3 101-111 decode
SH6	110110110	→ 110	→ 110	→ 110	→ 110110000	
PS7		110	110	110		
CP7		111	111	111		Tests: C1 110-011, C2 110-111, C3 110-111 decode
SH7	111111111	→ 111	→ 111	→ 111	→ 011111111	
PS8		111	111	111		
CP8		110	100	000		Tests: C1 111-110, C2 111-100, C3 111-000 decode
SH8	xxxxxxx	→ xxx	→ xxx	→ xxx	→ 110100000	

C3 Table

PS ABC	NS DEF ABC
000	011 011
001	010 010
010	101 101
011	100 100
100	101 101
101	111 111
110	111 111
111	000 000

C2 Table

PS ABC	NS DEF ABC
000	001 001
001	110 110
010	011 011
011	100 100
100	101 101
101	110 110
110	111 111
111	100 100

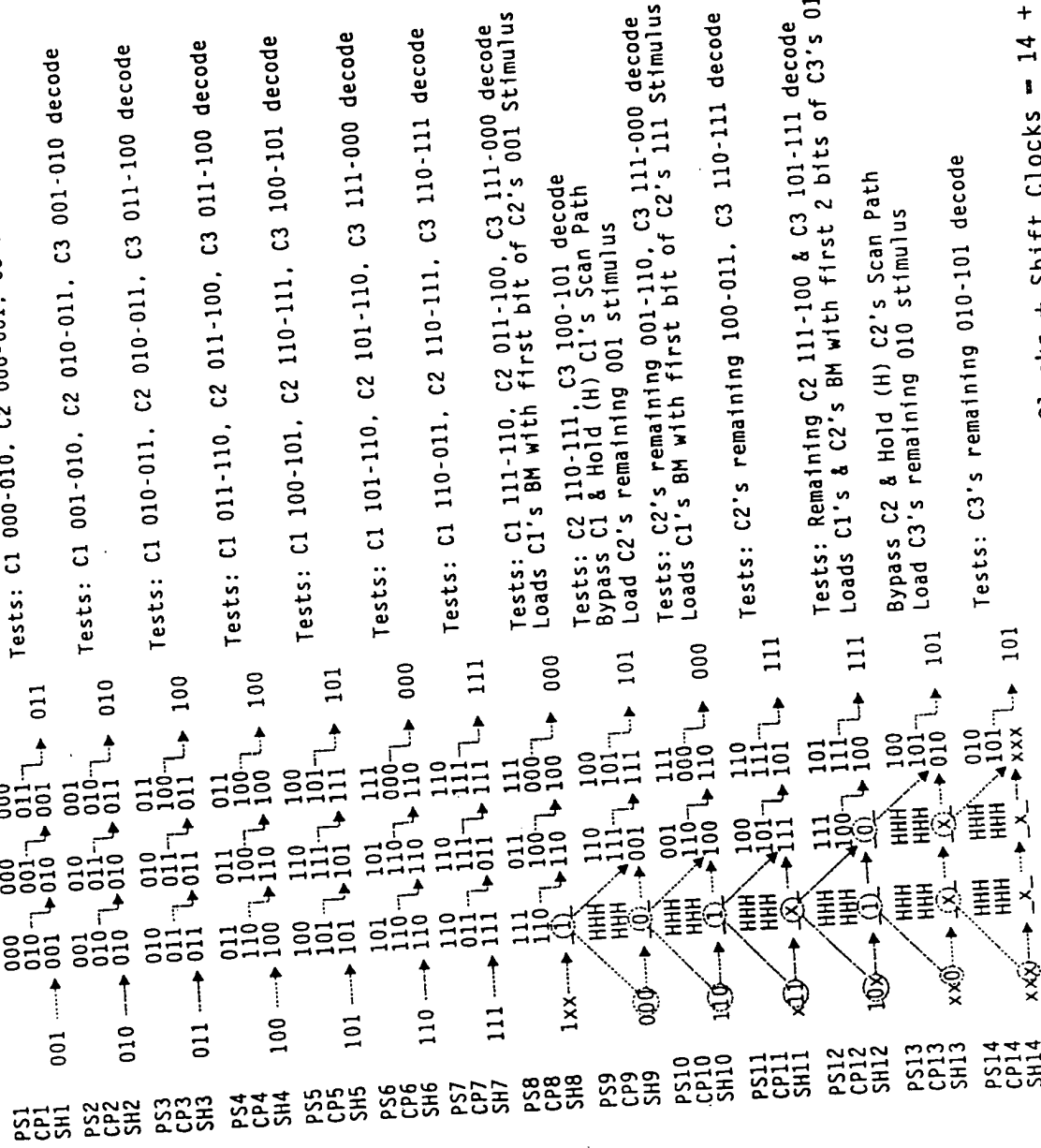
C1 Table

PS ABC	NS DEF ABC
000	010 010
001	010 010
010	011 011
011	110 110
100	101 101
101	110 110
110	011 011
111	110 110

Conventional Scan Test Clocks = Capture Clocks + Shift Clocks = 8 + 72 = 80

Example 2

SI C1 C2 C3 S0



C1 Table

PS	NS
ABC	DEF ABC
000	010 010
001	010 010
010	011 011
011	110 110
100	101 101
101	110 110
110	011 011
111	110 110

C2 Table

PS	NS
ABC	DEF ABC
000	001 001
001	110 110
010	011 011
011	100 100
100	101 101
101	110 110
110	111 111
111	100 100

C3 Table

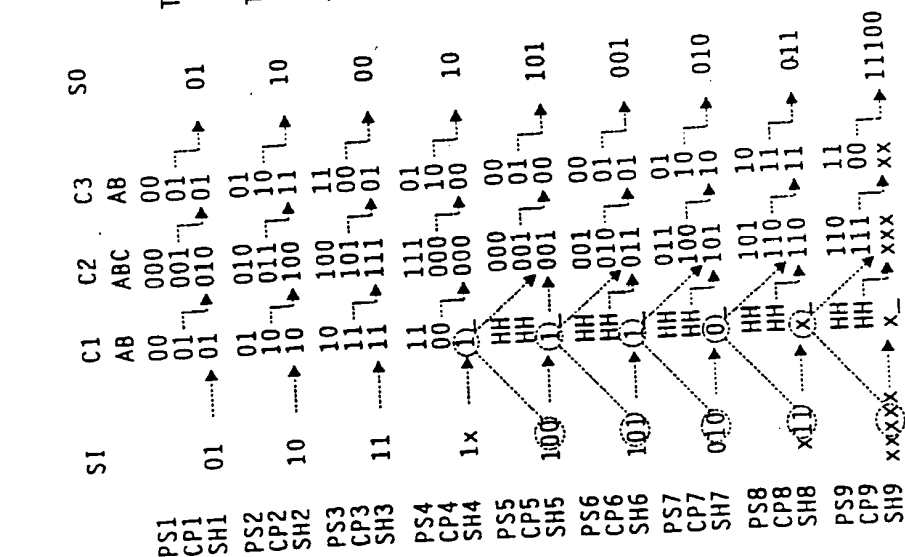
PS	NS
ABC	DEF ABC
000	011 011
001	010 010
010	101 101
011	100 100
100	101 101
101	111 111
110	111 111
111	000 000

Warping Scan Test Clocks = Capture Clocks + Shift Clocks = 14 + 42 = 56

Conventional Scan Test Clocks = Capture Clocks + Shift Clocks = 8 + 72 = 80

000001111100

Example 3



C1 Table

PS	NS
AB	CD AB
00	01 01
01	10 10
10	11 11
11	00 00

C2 Table

PS	NS
ABC	DEF ABC
000	001 001
001	010 010
010	011 011
011	100 100
100	101 101
101	110 110
110	111 111
111	000 000

C3 Table

PS	NS
AB	CD AB
00	01 01
01	10 10
10	11 11
11	00 00

Tests: C1 00-01, C2 000-001, C3 00-01 decode

Tests: C1 01-10, C2 010-011, C3 01-10 decode

Tests: C1 10-11, C2 100-101, C3 11-00 decode

Tests: C1 11-00, C2 111-000, C3 01-10 decode
Loads C1's BM with first bit of C2's 001 Stimulus

Tests: C2 000-001, C3 00-01 decode
Bypass C1 & Hold (H) C1's Scan Path
Load C2's remaining 001 stimulus

Tests: C2 001-010, C3 00-01 decode
Load C2's remaining 011 stimulus

Tests: C2 011-100, C3 01-10 decode
Load C2's remaining 101 stimulus

Tests: C2 101-110, C3 10-11 decode

Tests: C2 110-111, C3 11-00 decode

Warping Scan Test Clocks = Capture Clocks + Shift Clocks = 9 + 25 = 34
Conventional Scan Test Clocks = Capture Clocks + Shift Clocks = 8 + 56 = 64

001221-2-03541200

Example 4

C1 Table

PS ABC	NS DEF ABC
000	001 001
001	010 010
010	011 011
011	100 100
100	101 101
101	110 110
110	111 111
111	000 000

C2 Table

PS AB	NS CD AB
00	01 01
01	10 10
10	11 11
11	00 00

C3 Table

PS AB	NS CD AB
00	01 01
01	10 10
10	11 11
11	00 00

SI	C1 ABC	C2 AB	C3 AB	S0
PS1	000	00	00	
CP1	001	01	01	
SH1	001	00	10	101
PS2	001	00	10	
CP2	010	01	11	
SH2	010	01	00	111
PS3	010	01	00	
CP3	011	10	01	
SH3	011	01	11	001
PS4	011	01	11	
CP4	100	10	00	
SH4	100	10	01	000
PS5	100	10	01	
CP5	101	11	10	
SH5	101	10	11	110
PS6	101	10	11	
CP6	110	11	00	
SH6	110	11	01	100
PS7	110	11	01	
CP7	111	00	10	
SH7	111	11	10	010
PS8	111	11	10	
CP8	000	00	11	
SH8	xxx	xx	xx	0000011

Tests: C1 000-001, C2 00-01, C3 00-01 decode

Tests: C1 001-010, C2 00-01, C3 10-11 decode

Tests: C1 010-011, C2 01-10, C3 00-01 decode

Tests: C1 011-100, C2 01-10, C3 11-00 decode

Tests: C1 100-101, C2 10-11, C3 01-10 decode

Tests: C1 101-110, C2 10-11, C3 11-00 decode

Tests: C1 110-111, C2 11-00, C3 01-10 decode

Tests: C1 111-000, C2 11-00, C3 10-11 decode

Warping Scan Test Clocks = Capture Clocks + Shift Clocks = 8 + 28 = 36

Conventional Scan Test Clocks = Capture Clocks + Shift Clocks = 8 + 56 = 64

Output - Example 5

Example 5

C1 Table

PS	NS
ABC	DEF ABC
000	001 001
001	010 010
010	011 011
011	100 100
100	101 101
101	110 110
110	111 111
111	000 000

C2 Table

PS	NS
ABC	DEF ABC
000	010 010
001	010 011
010	100 100
011	100 101
100	110 110
101	110 111
110	000 000
111	000 001

SI	C1	C2	S0
ABC	ABC	ABC	
PS1	000	000	
CP1	001	010	
SH1	001	001	010
			Tests: C1 000-001, C2 000-010 decode
PS2	001	001	
CP2	010	011	
SH2	010	010	011
			Tests: C1 001-010, C2 001-011 decode
PS3	010	010	
CP3	011	100	
SH3	011	011	100
			Tests: C1 010-011, C2 010-100 decode
PS4	011	011	
CP4	100	101	
SH4	100	100	101
			Tests: C1 011-100, C2 011-101 decode
PS5	100	100	
CP5	101	110	
SH5	101	101	110
			Tests: C1 100-101, C2 100-110 decode
PS6	101	101	
CP6	110	111	
SH6	110	110	111
			Tests: C1 101-110, C2 101-111 decode
PS7	110	110	
CP7	111	000	
SH7	111	111	000
			Tests: C1 110-111, C2 110-000 decode
PS8	111	111	
CP8	000	001	
SH8	xxx	000	000001
			Tests: C1 111-000, C2 111-001 decode

Warping Scan Test Clocks = Capture Clocks + Shift Clocks = 8 + 27 = 35

Conventional Scan Test Clocks = Capture Clocks + Shift Clocks = 8 + 48 = 56

Example 6

C1 Table

PS ABC	NS DEF ABC
000	001 001
001	010 010
010	011 011
011	100 100
100	101 101
101	110 110
110	111 111
111	000 000

C2 Table

PS ABC	NS DE ABC
000	01 010
001	10 101
010	11 110
011	00 001
100	01 010
101	10 101
110	11 110
111	00 001

SI	C1 ABC	C2 ABC	S0	Tests
PS1	000	000	010	C1 000-001, C2 000-010 decode
CP1	001	010		
SH1	001	001		
PS2	010	010	101	C1 001-010, C2 001-101 decode
CP2	010	101		
SH2	010	010		
PS3	011	010	110	C1 010-011, C2 010-110 decode
CP3	011	110		
SH3	011	011		
PS4	100	011	001	C1 011-100, C2 011-001 decode
CP4	100	001		
SH4	100	100		
PS5	101	100	010	C1 100-101, C2 100-010 decode
CP5	101	010		
SH5	101	101		
PS6	110	101	101	C1 101-110, C2 101-101 decode
CP6	110	101		
SH6	110	110		
PS7	111	110	110	C1 110-111, C2 110-110 decode
CP7	111	110		
SH7	111	111		
PS8	xxx	111	000001	C1 111-000, C2 111-001 decode
CP8	xxx	000		
SH8	xxx	000		

Warping Scan Test Clocks = Capture Clocks + Shift Clocks = 8 + 27 = 35

Conventional Scan Test Clocks = Capture Clocks + Shift Clocks = 8 + 48 = 56

Output - Example 70

	SI	C1 ₁ ABC	C1 ₂ ABC	C1 _{N-1} ABC	C1 _N ABC	S0
PS1	001	001	001	001	001	001
CP1	001	001	001	001	001	001
SH1	001	001	001	001	001	001
PS2	010	001	001	001	001	010
CP2	010	010	010	010	010	010
SH2	010	010	010	010	010	010
PS3	011	010	010	010	010	011
CP3	011	011	011	011	011	011
SH3	011	011	011	011	011	011
PS4	100	011	011	011	011	100
CP4	100	100	100	100	100	100
SH4	100	100	100	100	100	100
PS5	101	100	100	100	100	101
CP5	101	101	101	101	101	101
SH5	101	101	101	101	101	101
PS6	110	101	101	101	101	110
CP6	110	110	110	110	110	110
SH6	110	110	110	110	110	110
PS7	111	110	110	110	110	111
CP7	111	111	111	111	111	111
SH7	111	111	111	111	111	111
PS8	xxx...xxx	111	111	111	111	xxx...xxx
CP8	xxx...xxx	000	000	000	000	xxx...xxx
SH8	xxx...xxx	xxx	xxx	xxx	xxx	xxx...xxx

C1 Table

PS	NS
ABC	DEF
000	001 001
001	010 010
010	011 011
011	100 100
100	101 101
101	110 110
110	111 111
111	000 000

For L=2000, P=1000, N=1
 Warping Scan Test Clocks = 2,000,000
 Conventional Scan Test Clocks = 200,000,000

For L=2000, P=1000, N=100
 Warping Scan Test Clocks = 2,198,000
 Conventional Scan Test Clocks = 200,000,000

For L=2000, P=1000, N=1000
 Warping Scan Test Clocks = 3,998,000
 Conventional Scan Test Clocks = 2,000,000,000

P = Circuit's test pattern count
 L = Circuit's scan path length
 C = Capture clock per test pattern
 N = Number of circuits

Warping Scan Test Clocks = $P(C+L) + NL-L$
 Conventional Scan Test Clocks = $P(C+NL)$

For large L & P
 Warping Scan Test Clocks = $L(P+(N-1))$
 Conventional Scan Test Clocks = LPN

FIG. 1 (PRIOR ART)

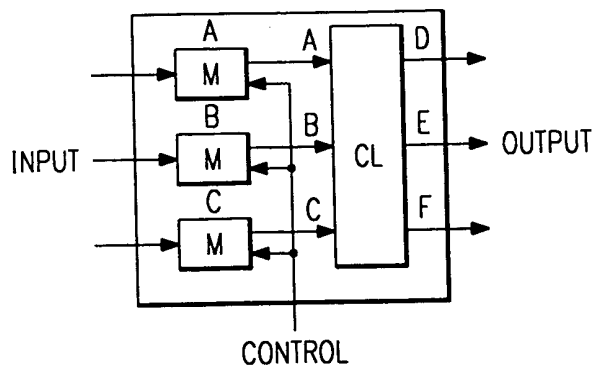


FIG. 2 (PRIOR ART)

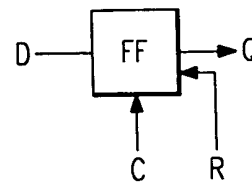


FIG. 3 (PRIOR ART)

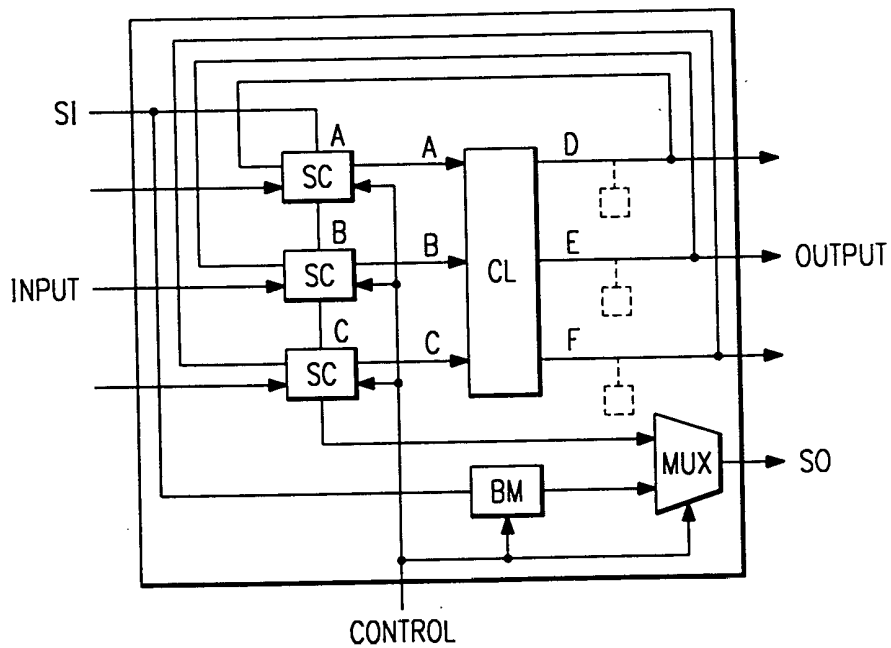


FIG. 4A (PRIOR ART)

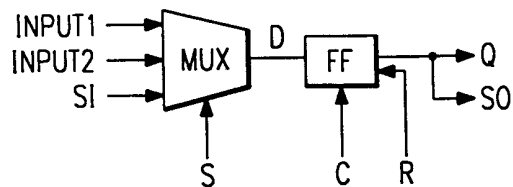


FIG. 4B (PRIOR ART)

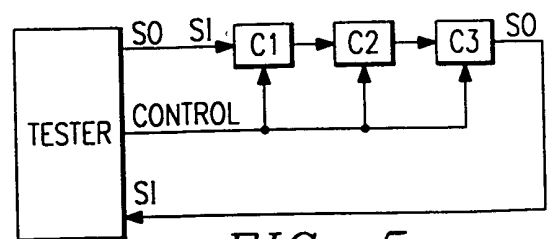
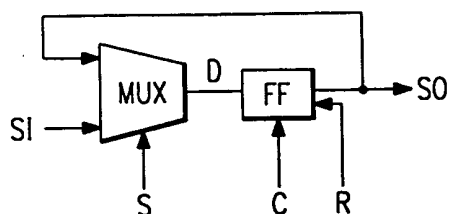


FIG. 5 (PRIOR ART)

FIG. 6
(PRIOR ART)

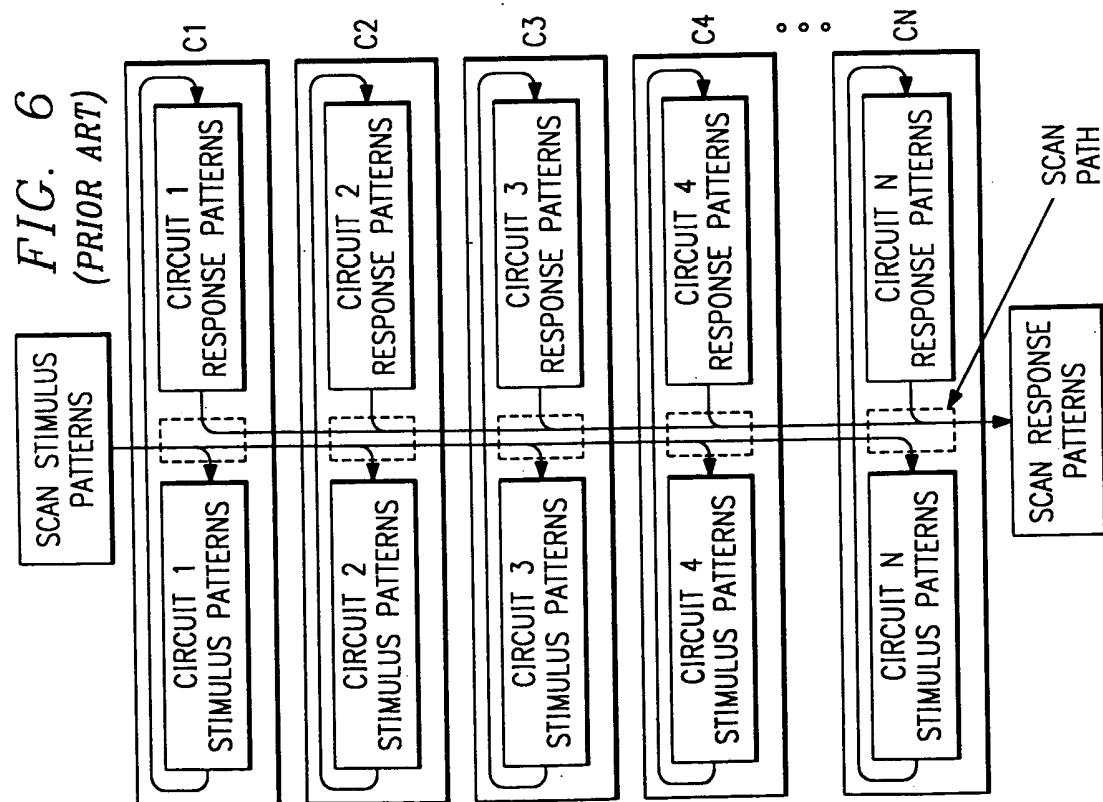


FIG. 7

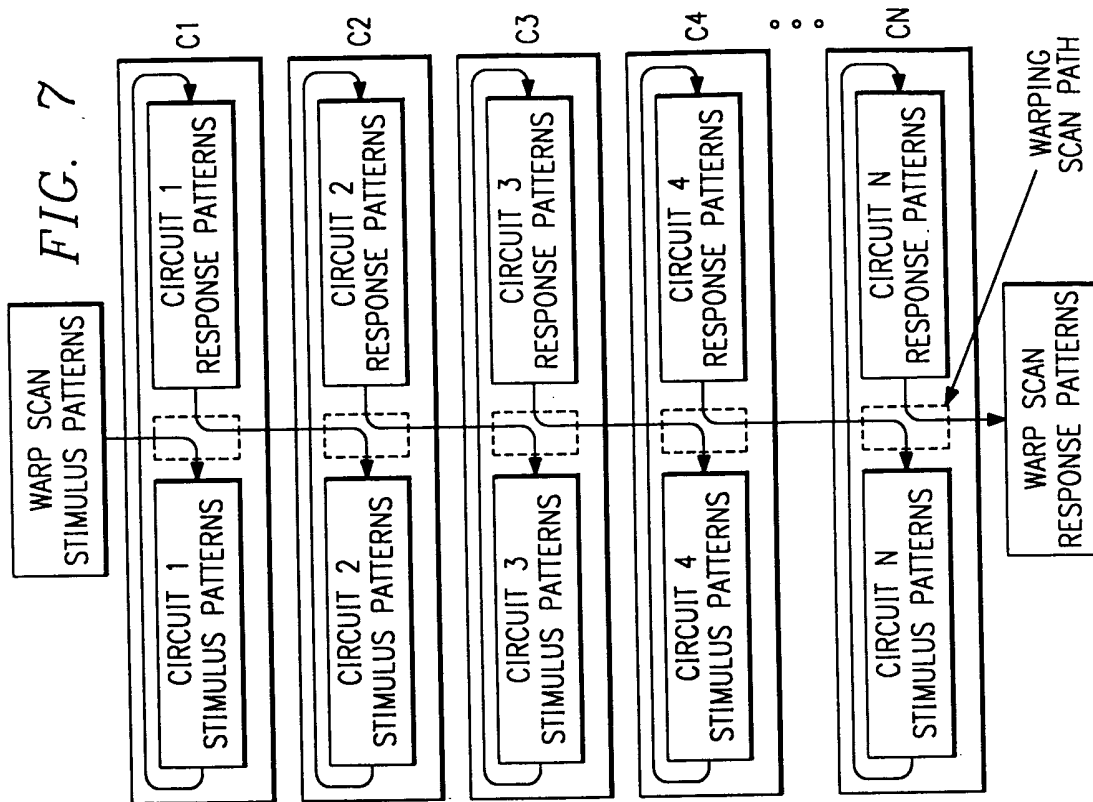


FIG. 8

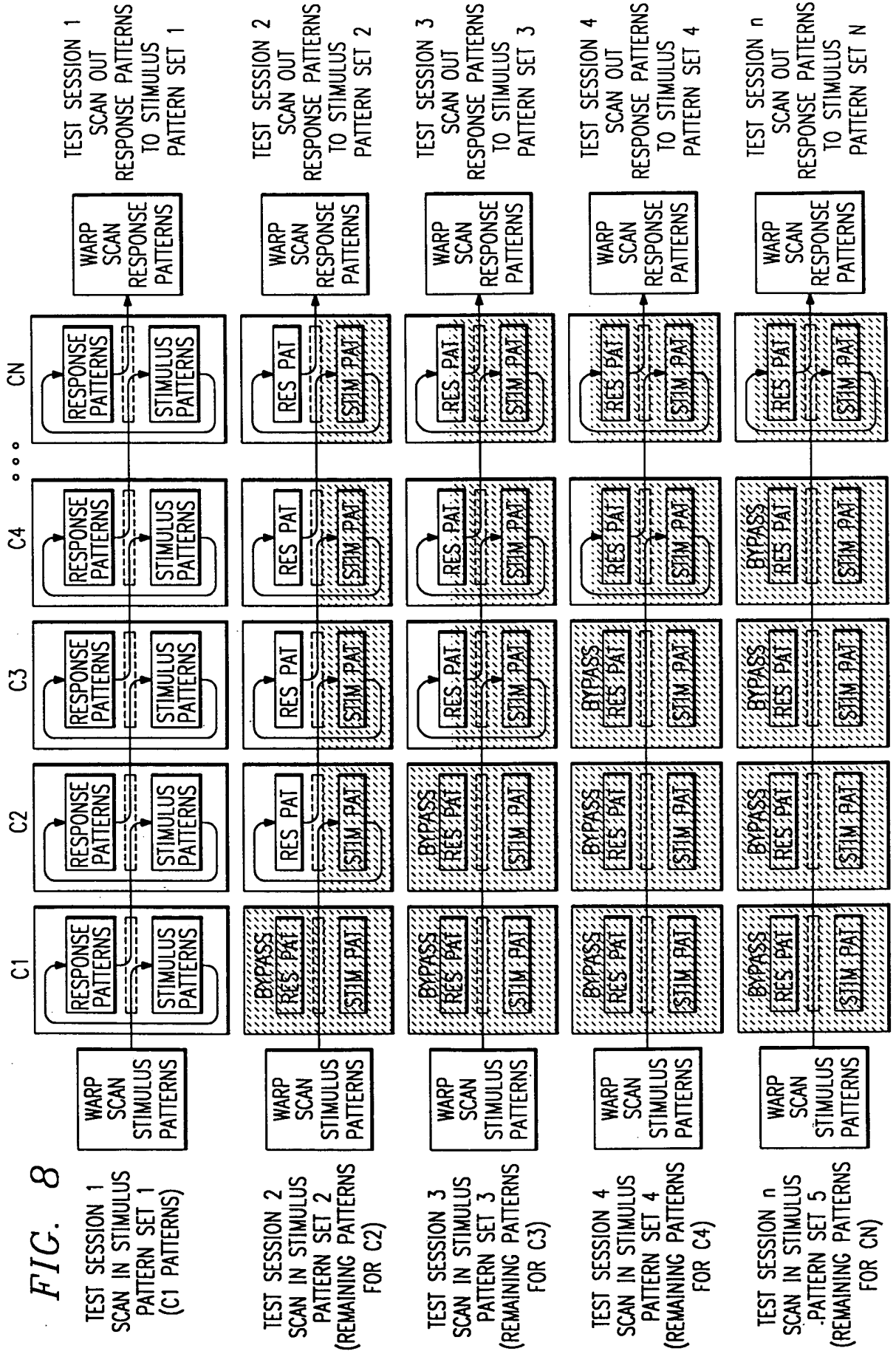


FIG. 9

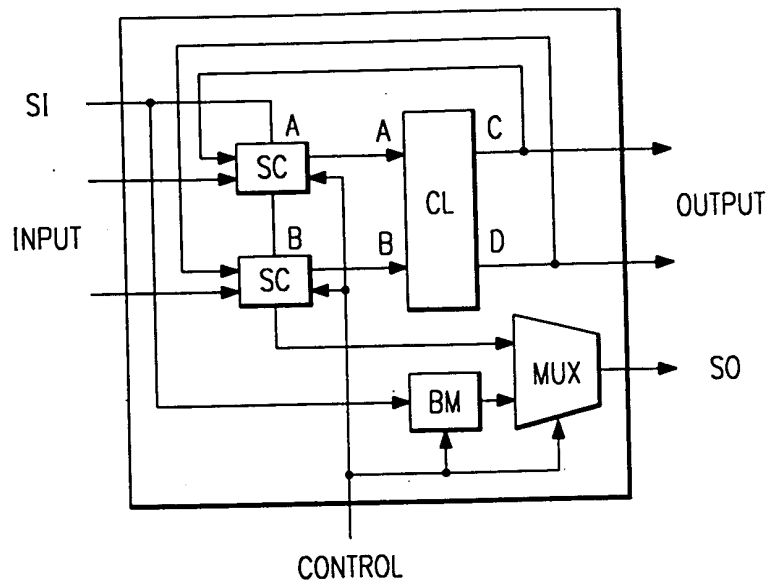


FIG. 10

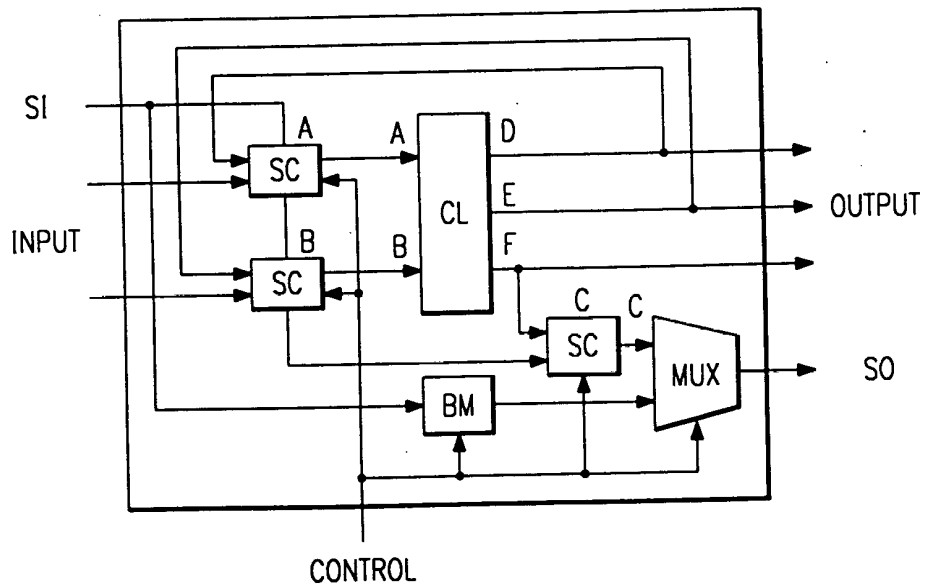
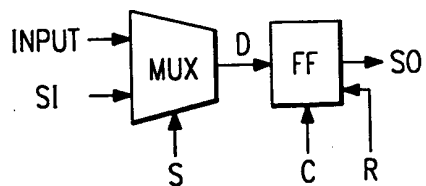


FIG. 11



007453-12400

FIG. 12

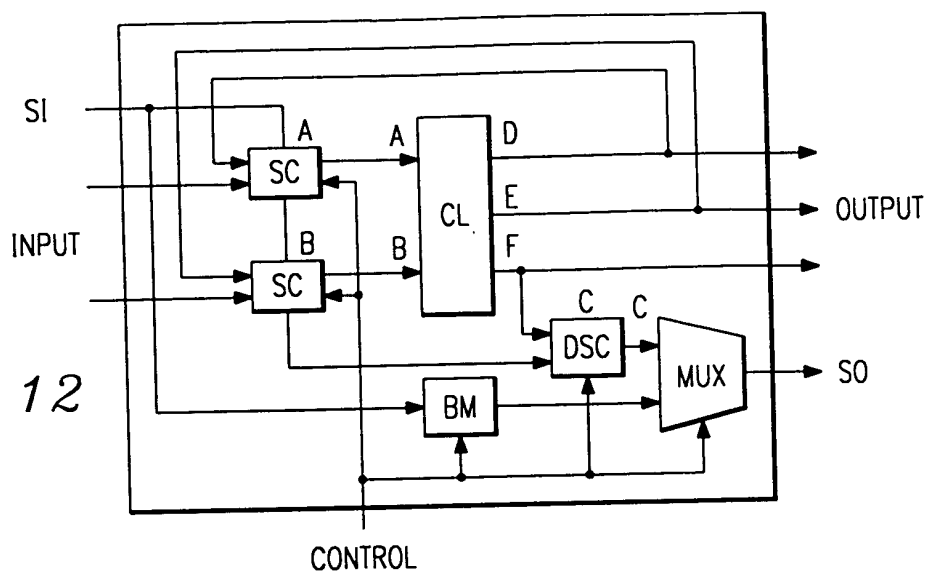


FIG. 13

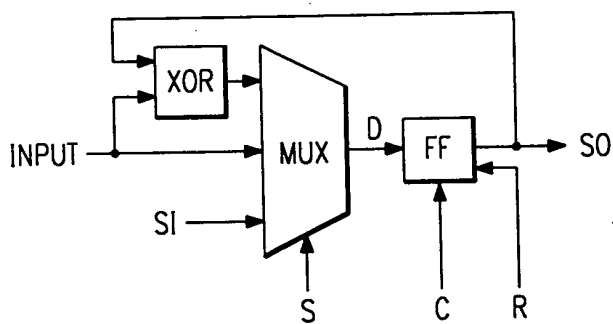


FIG. 15

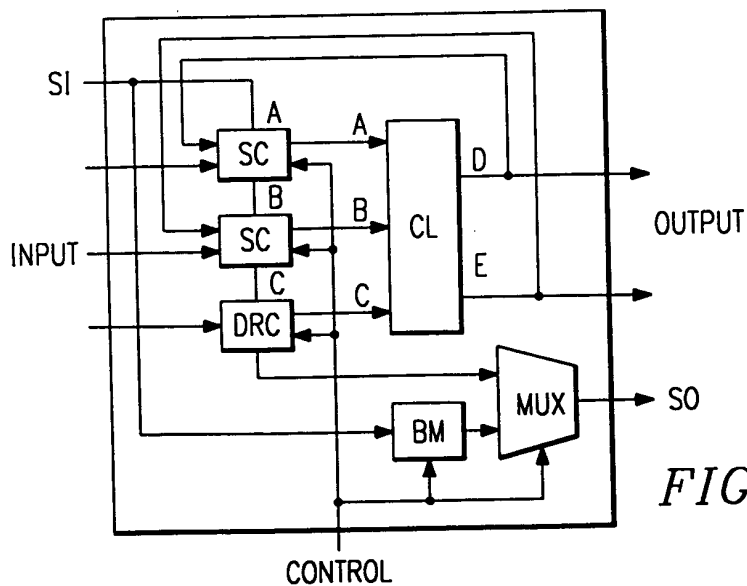
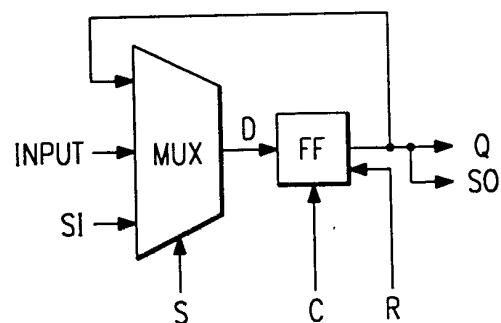


FIG. 14

FIG. 16

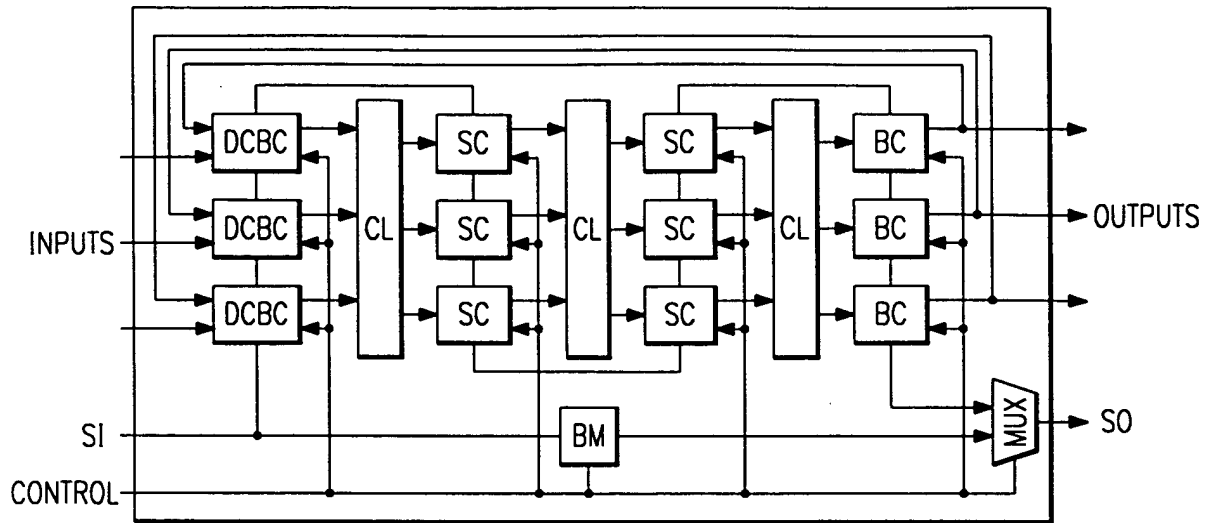


FIG. 17

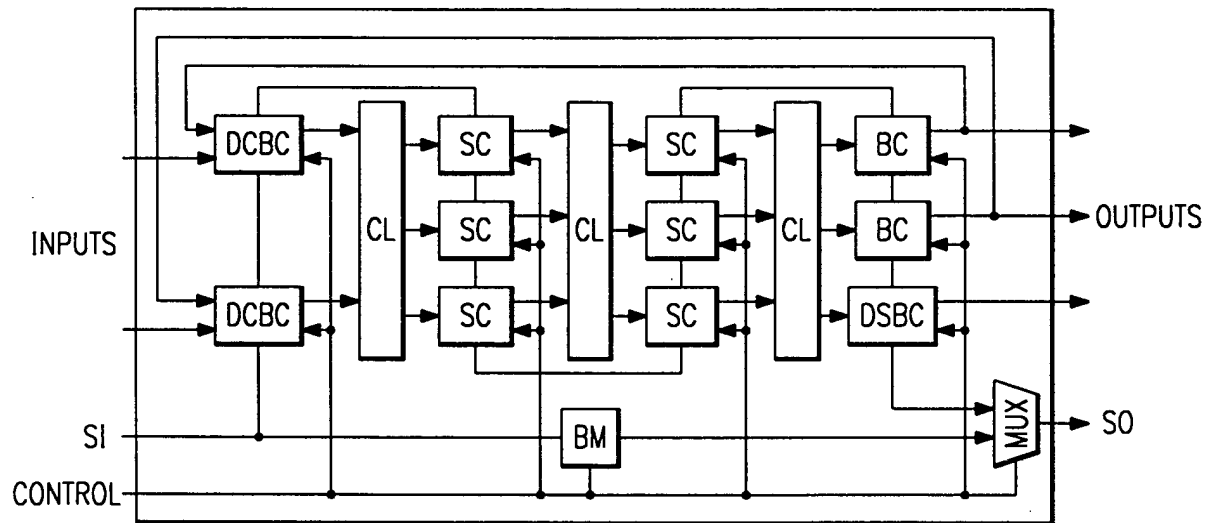


FIG. 18

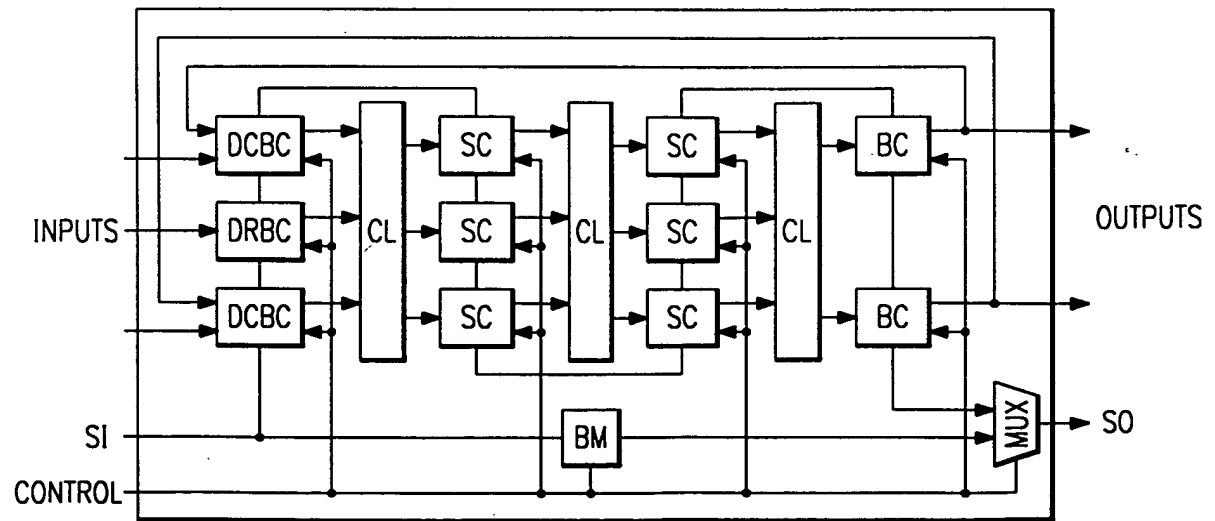


FIG. 19

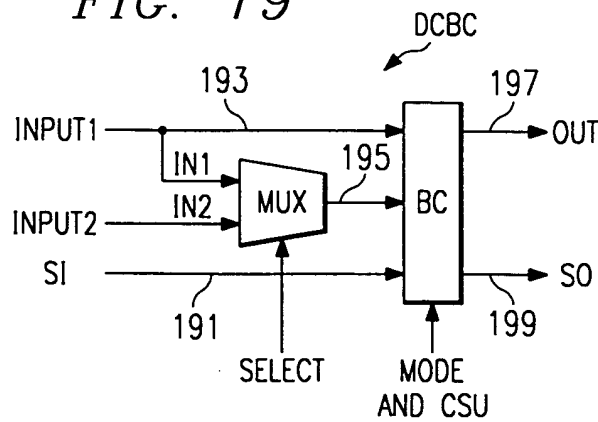


FIG. 20

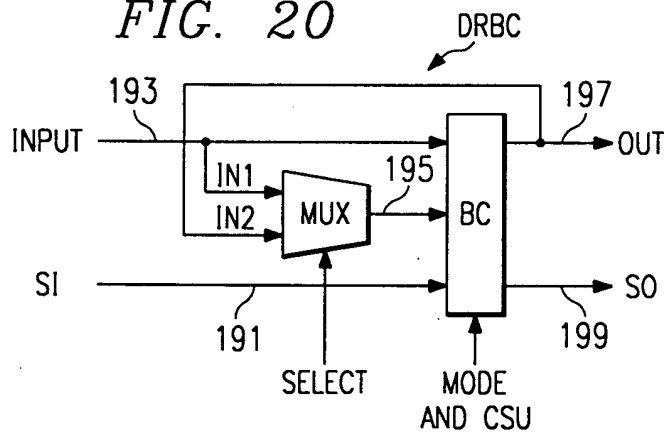
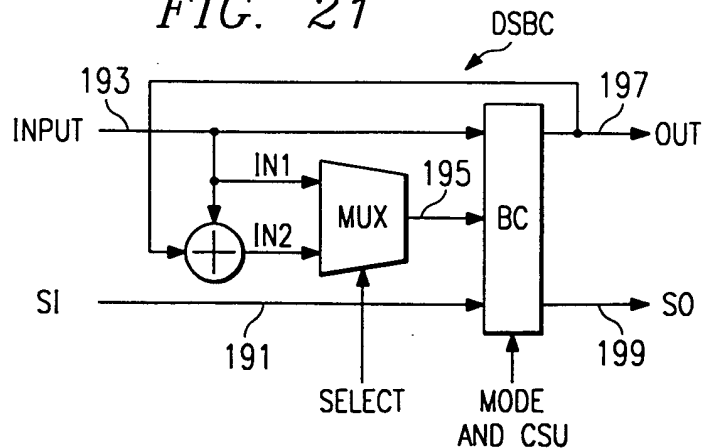


FIG. 21



SELECT = CONVENTIONAL OR WARP SCAN MODE
MODE = CONVENTIONAL BC NORMAL OR TEST MODE CONTROL
CSU = CONVENTIONAL BC CAPTURE, SHIFT, UPDATE CONTROL

001001-10000000

FIG. 21A

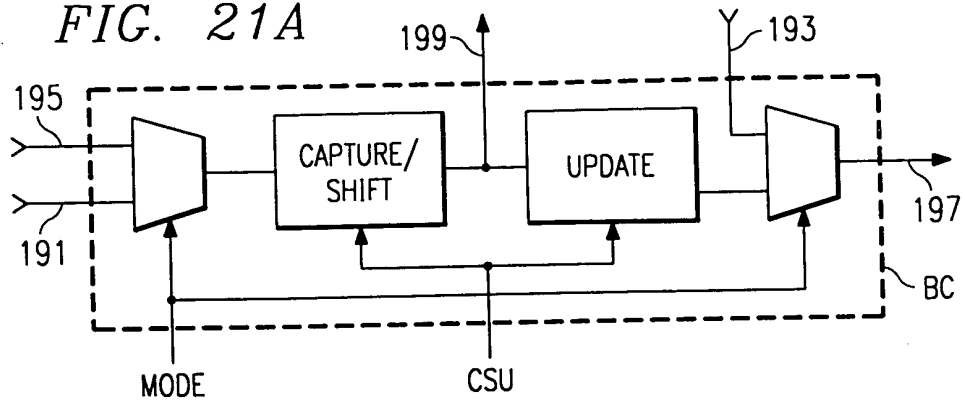


FIG. 22

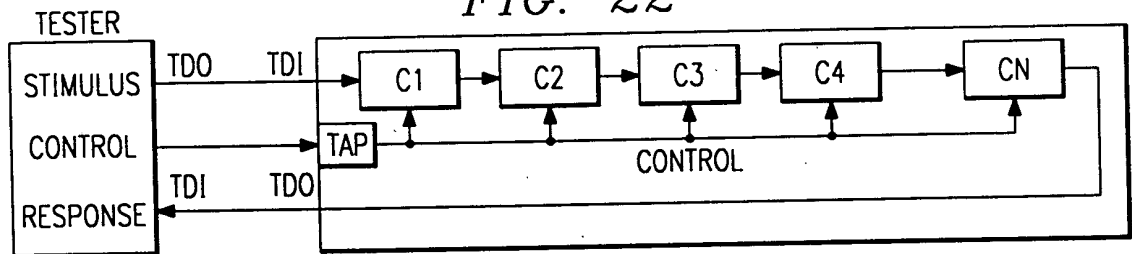


FIG. 23

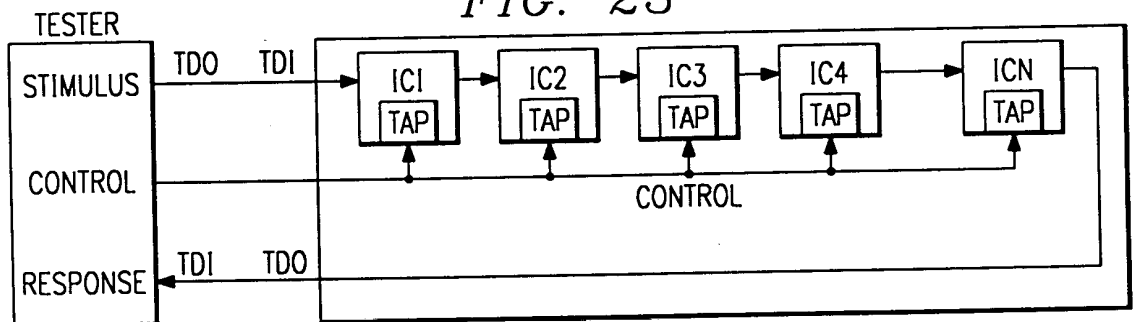


FIG. 24

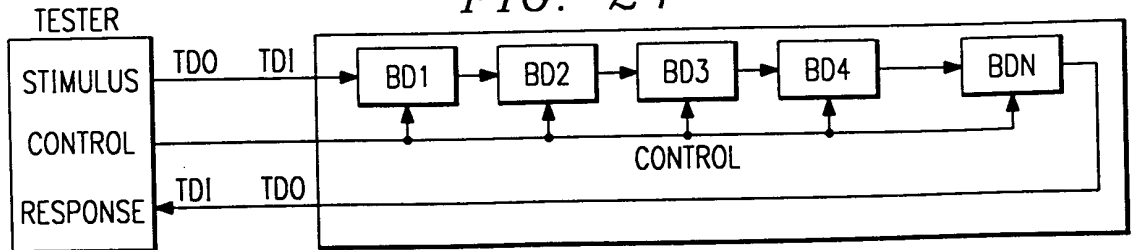
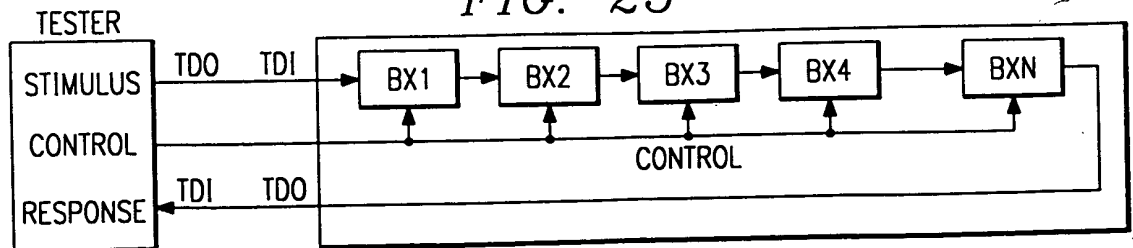


FIG. 25



001221-6694200

FIG. 26

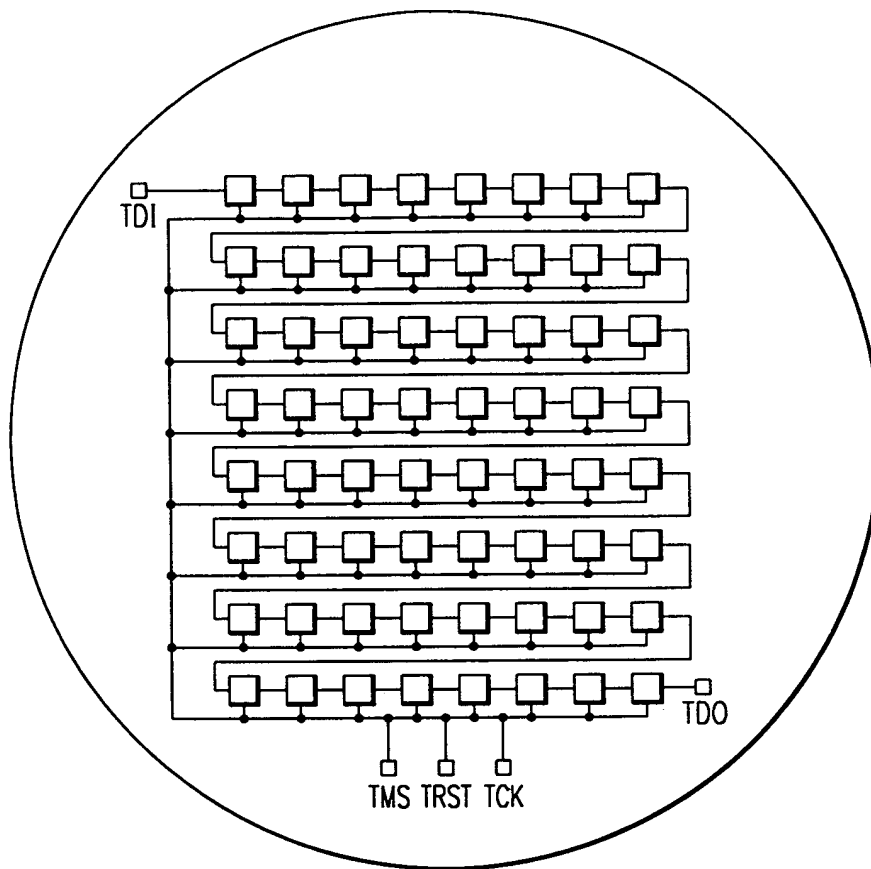


FIG. 27

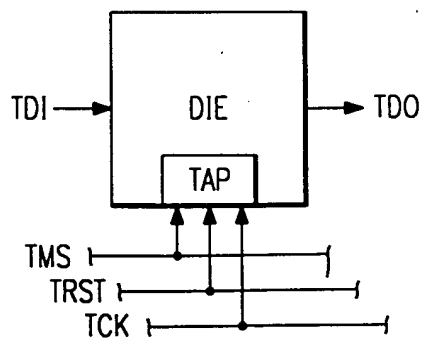
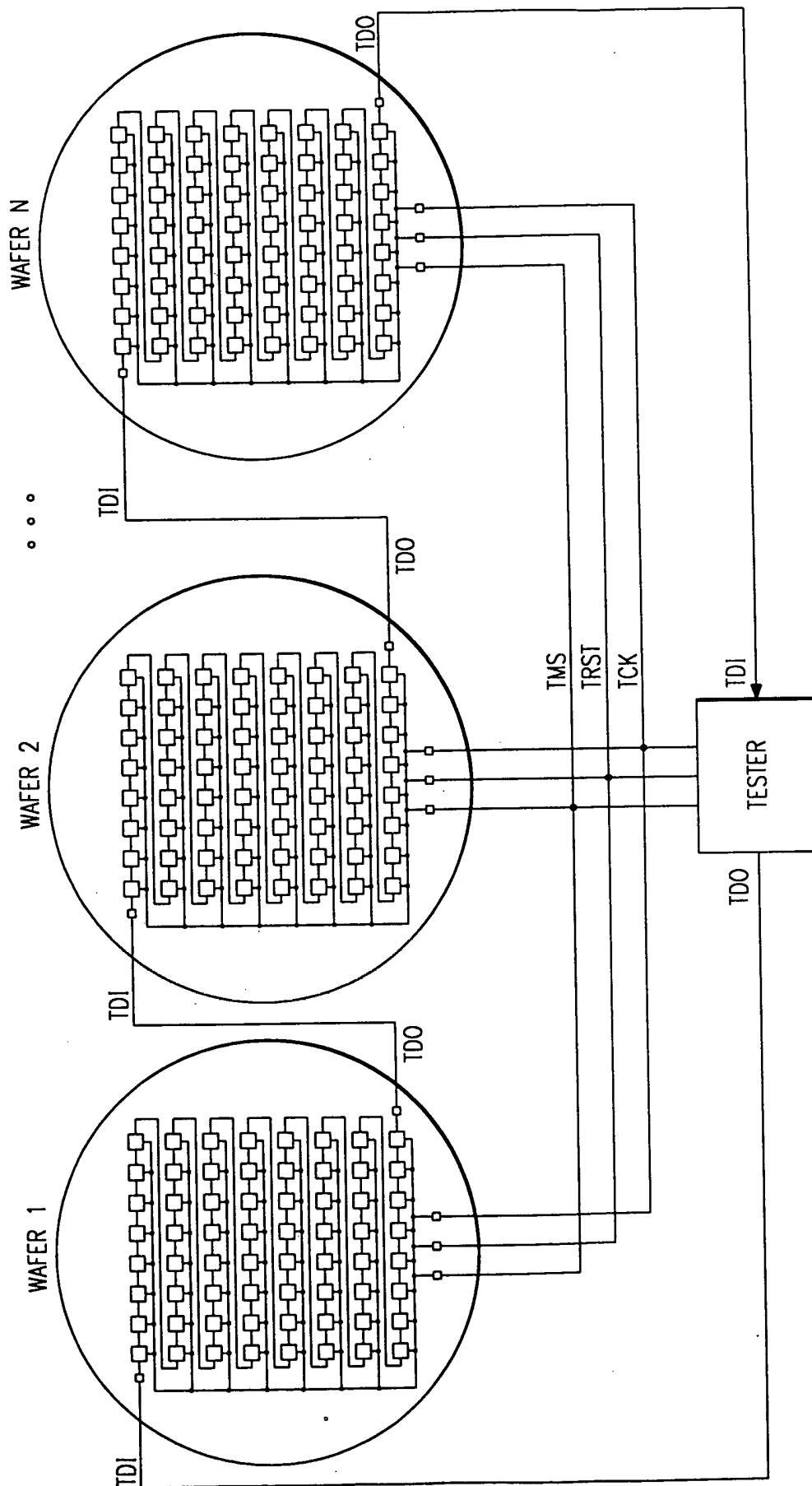
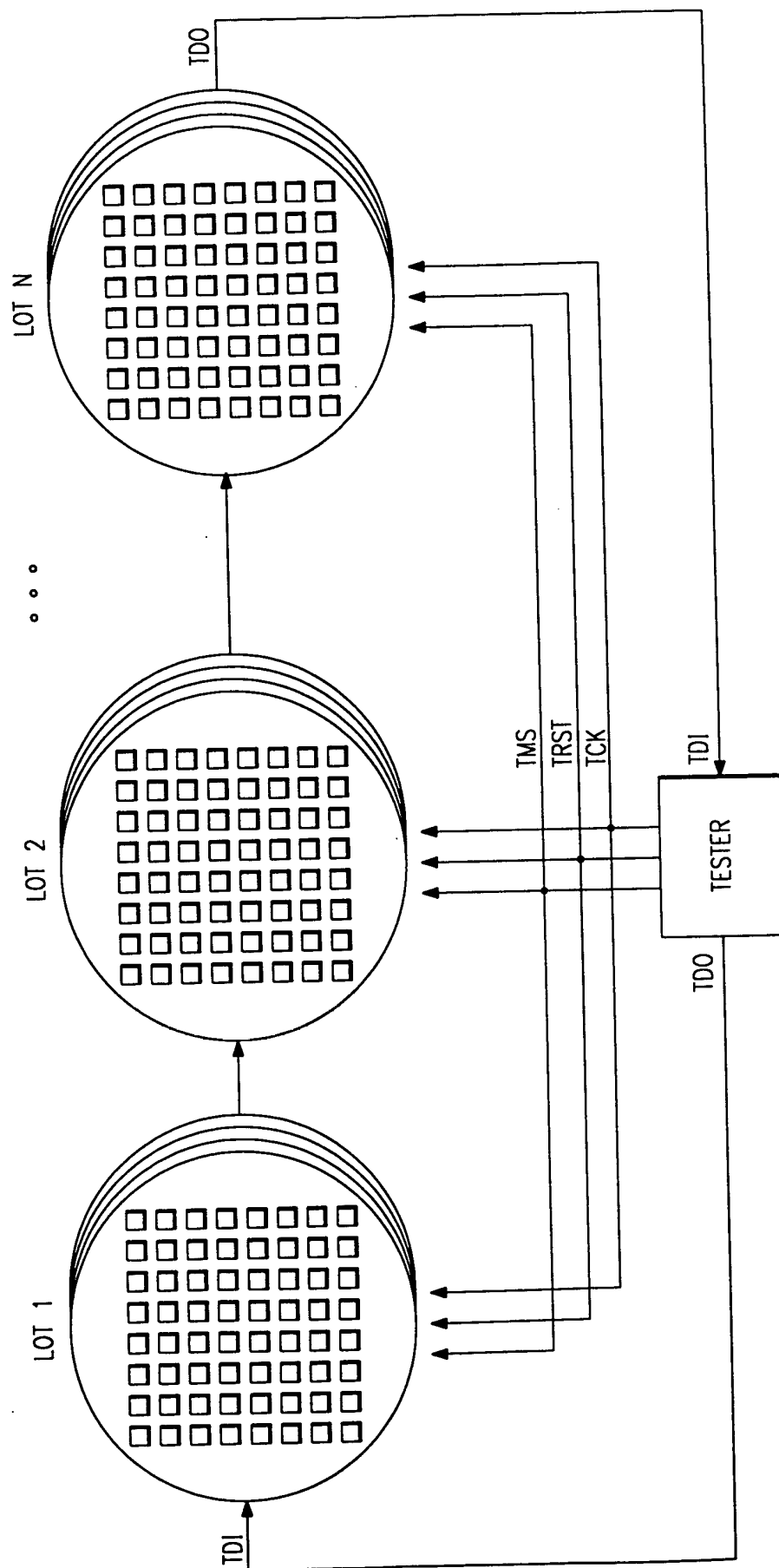


FIG. 28



007227-2 00000000

FIG. 29



007347-6344200

FIG. 30

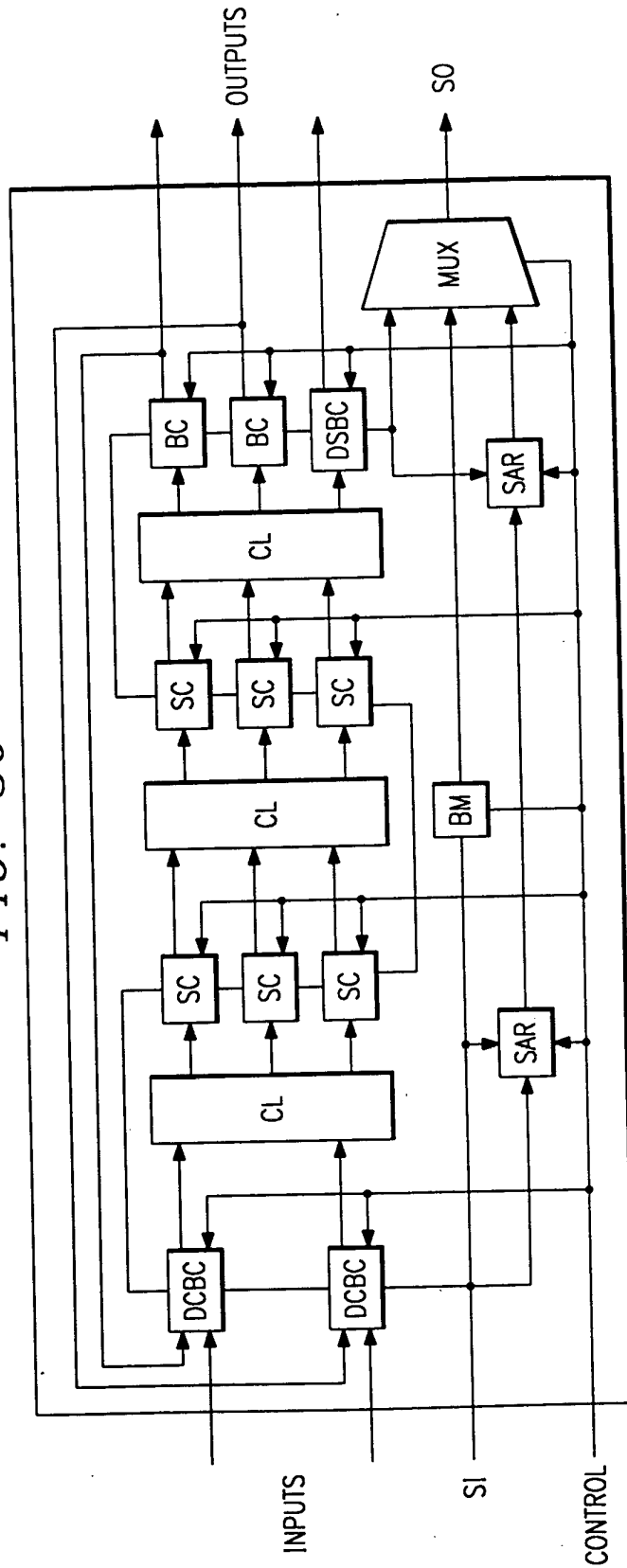


FIG. 31

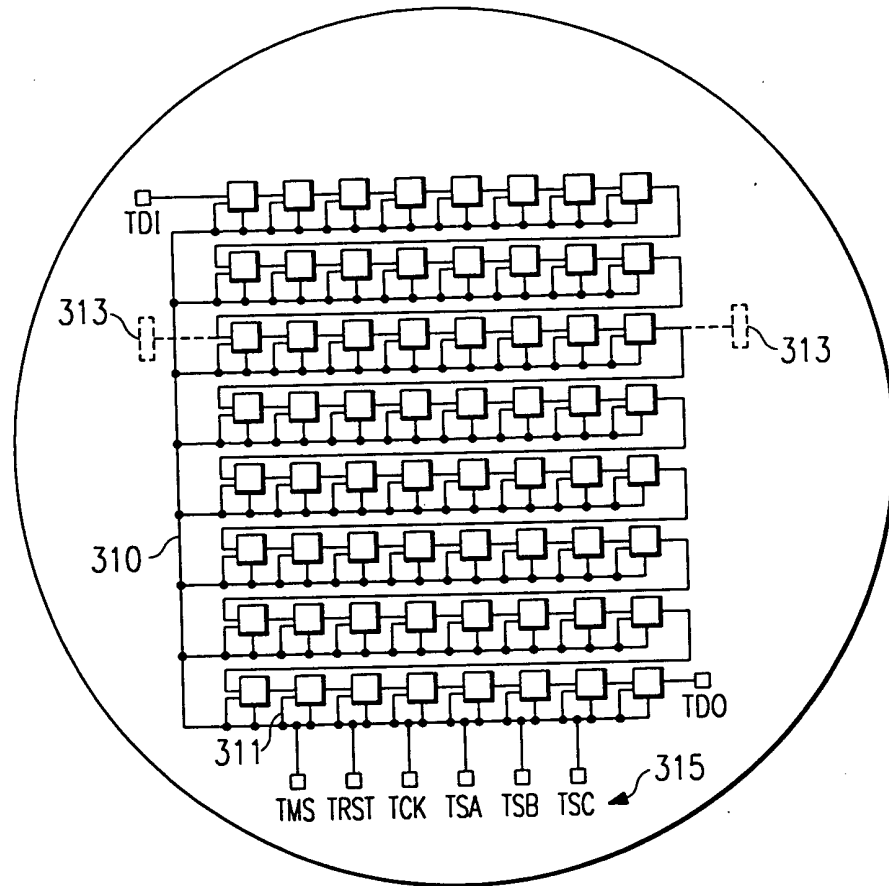


FIG. 32

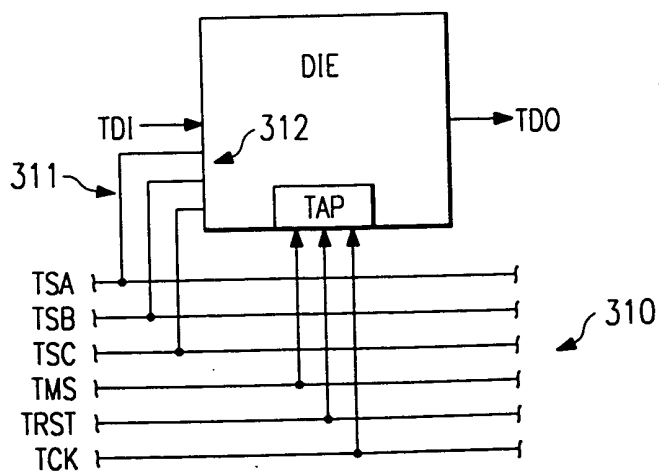


FIG. 33
(PRIOR ART)

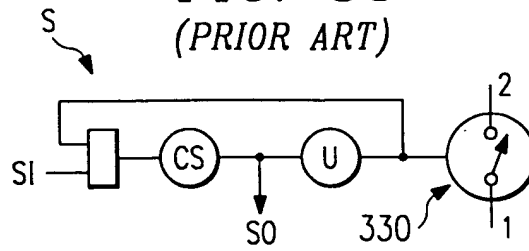


FIG. 34

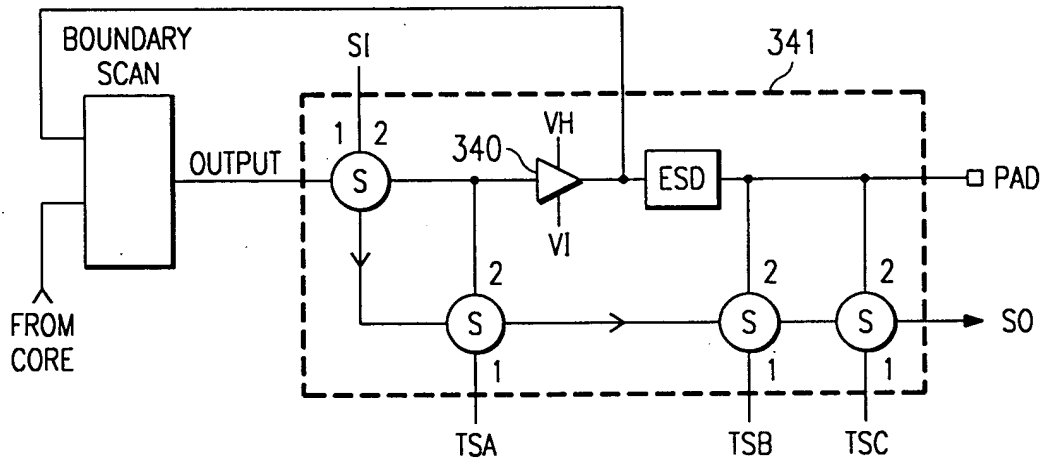


FIG. 35

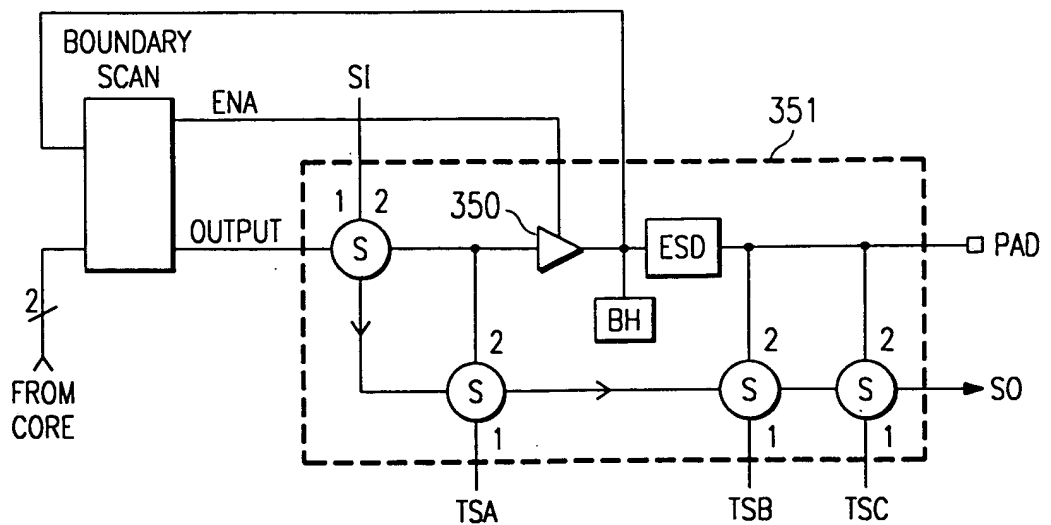


FIG. 36

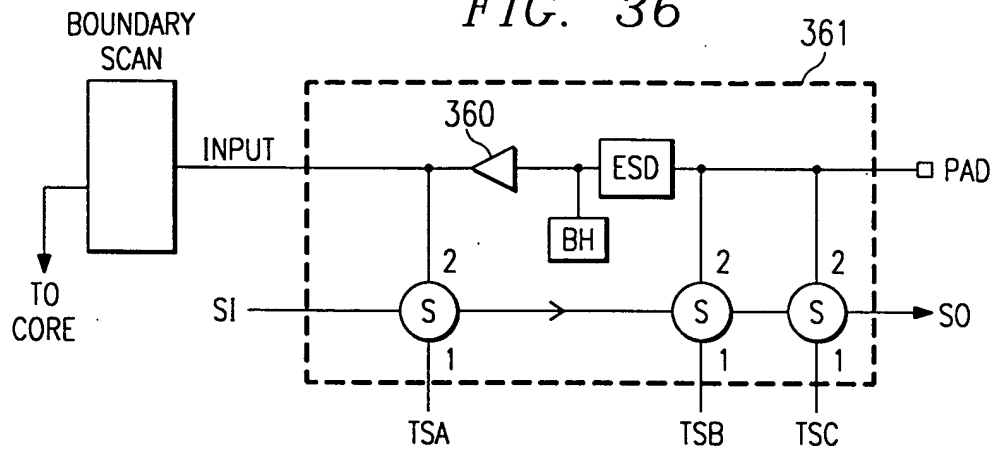


FIG. 37

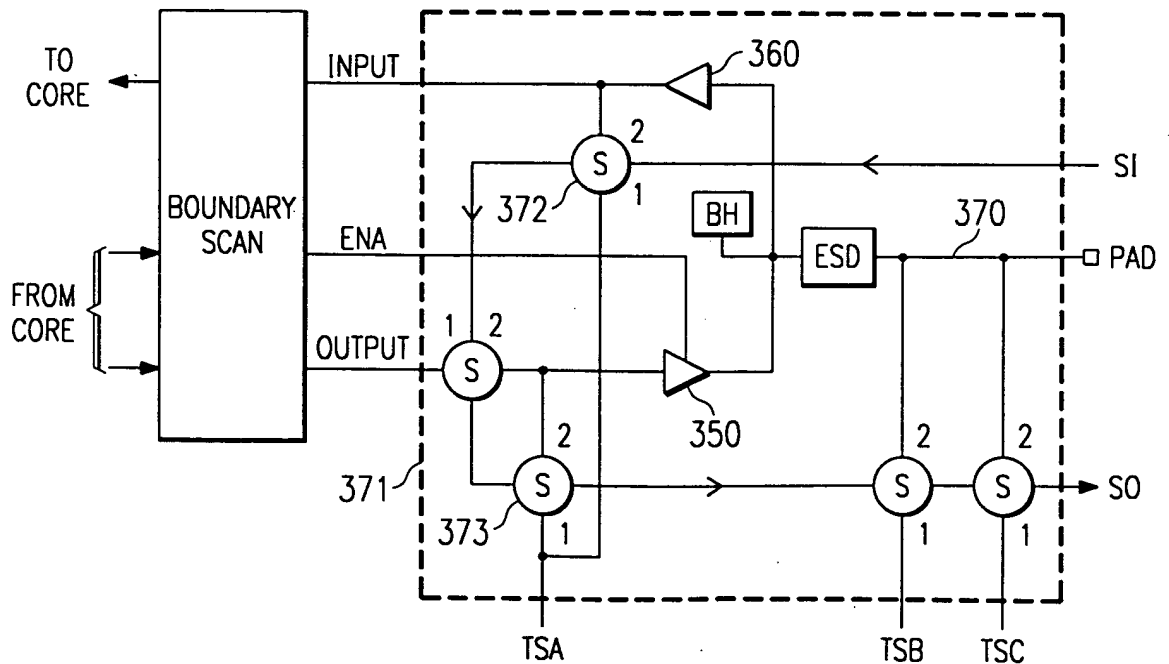


FIG. 38

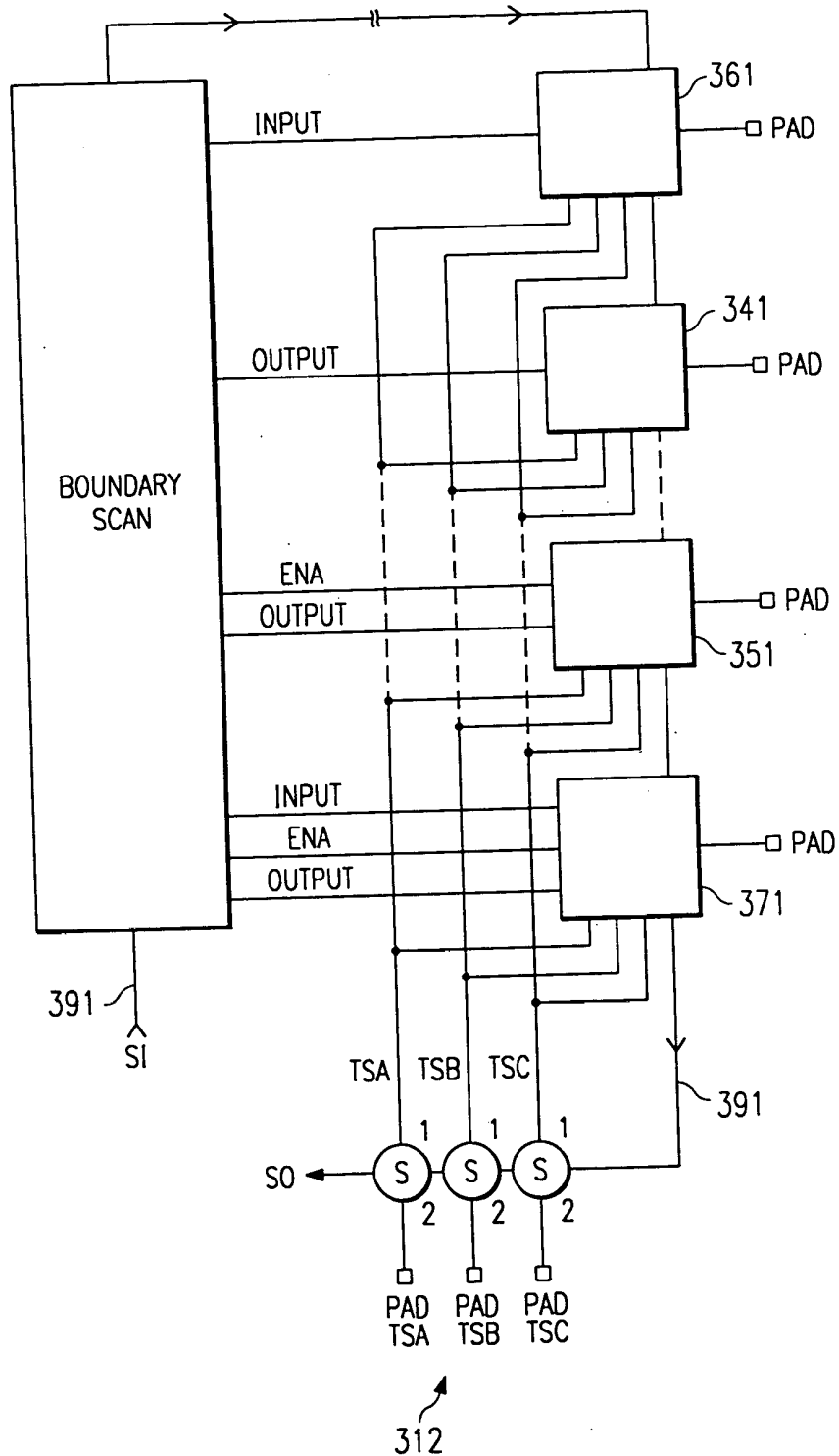


FIG. 39B
(PRIOR ART)

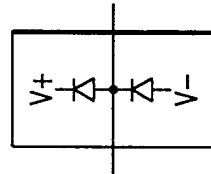


FIG. 39C
(PRIOR ART)

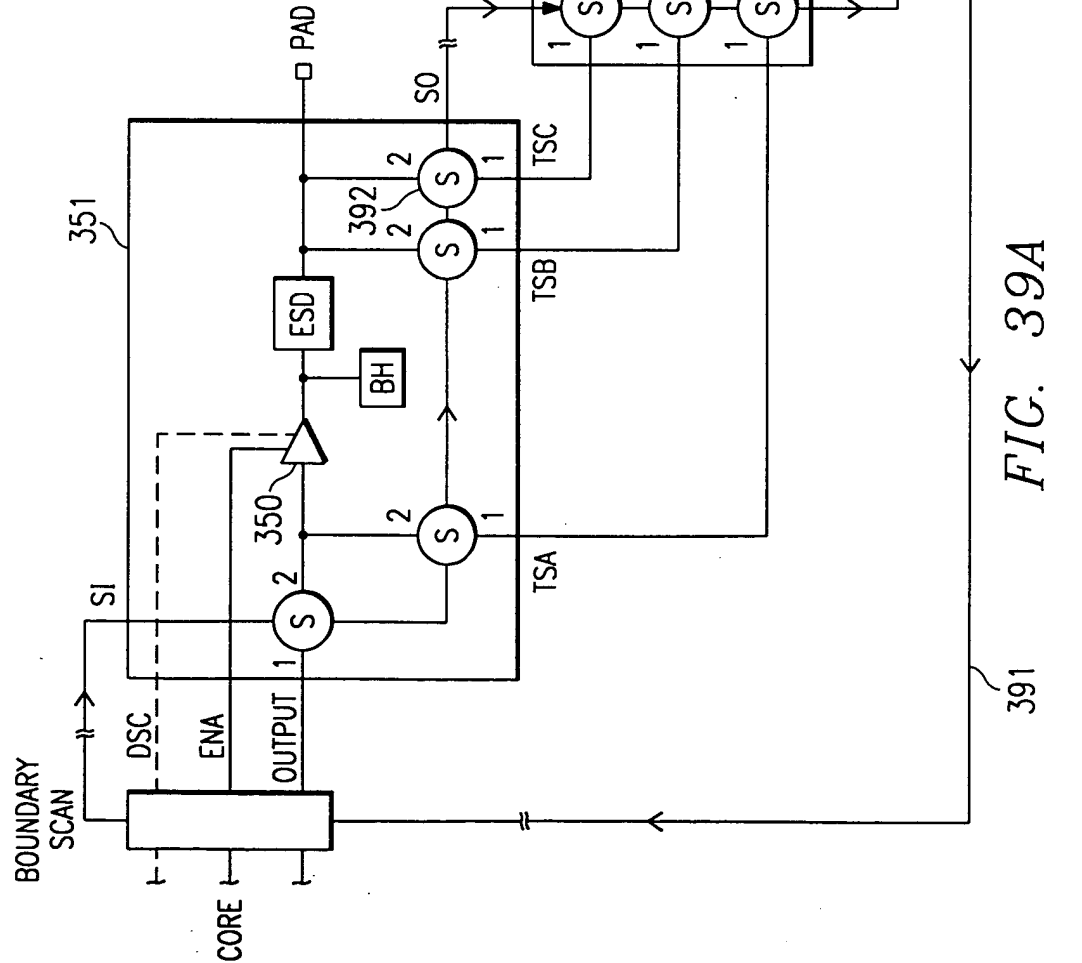
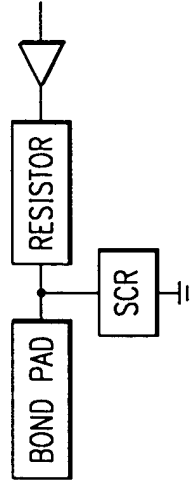


FIG. 39A

FIG. 40B
(PRIOR ART)

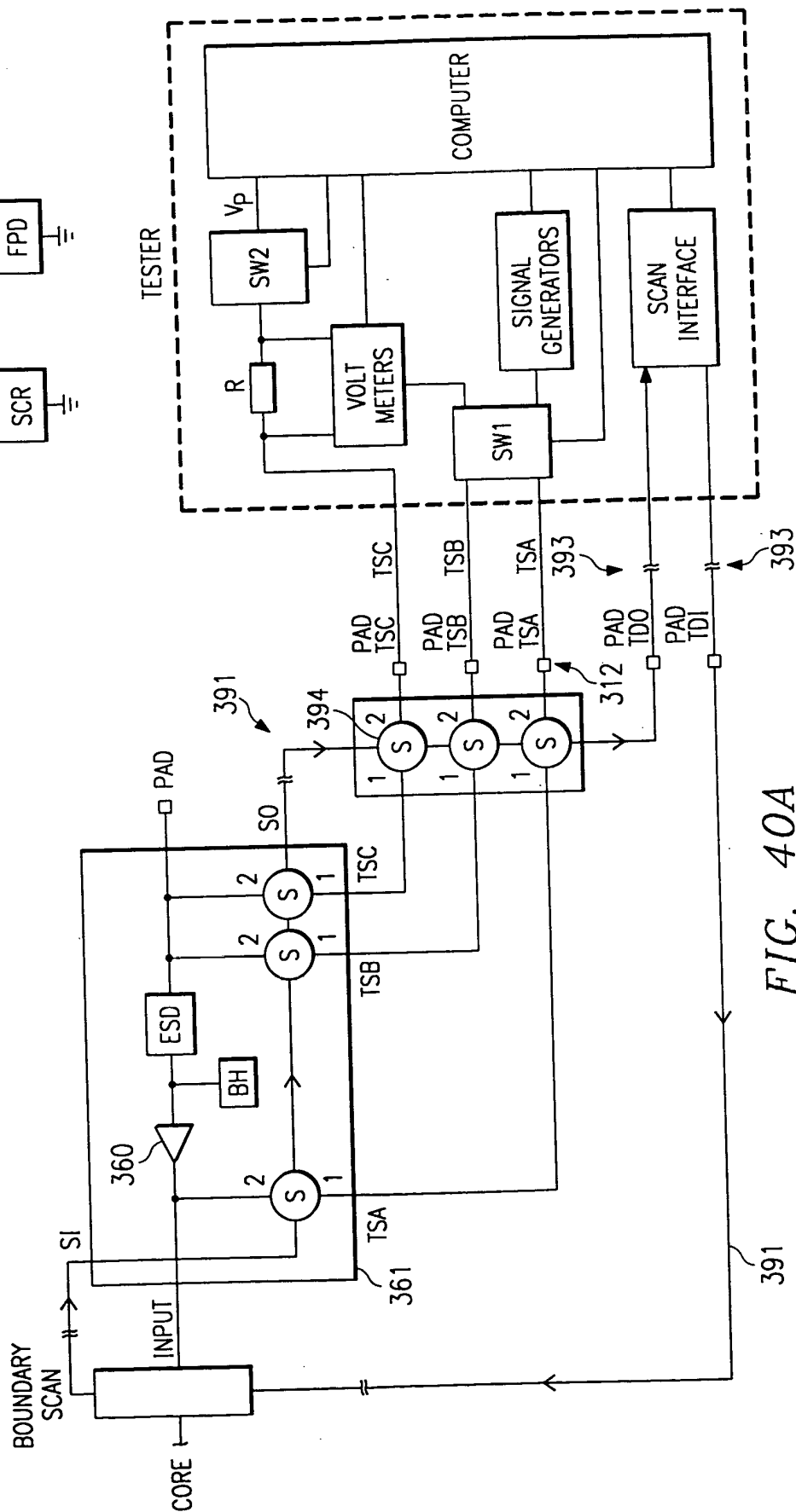
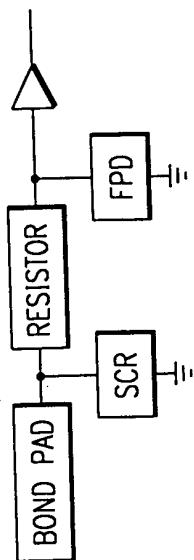


FIG. 41

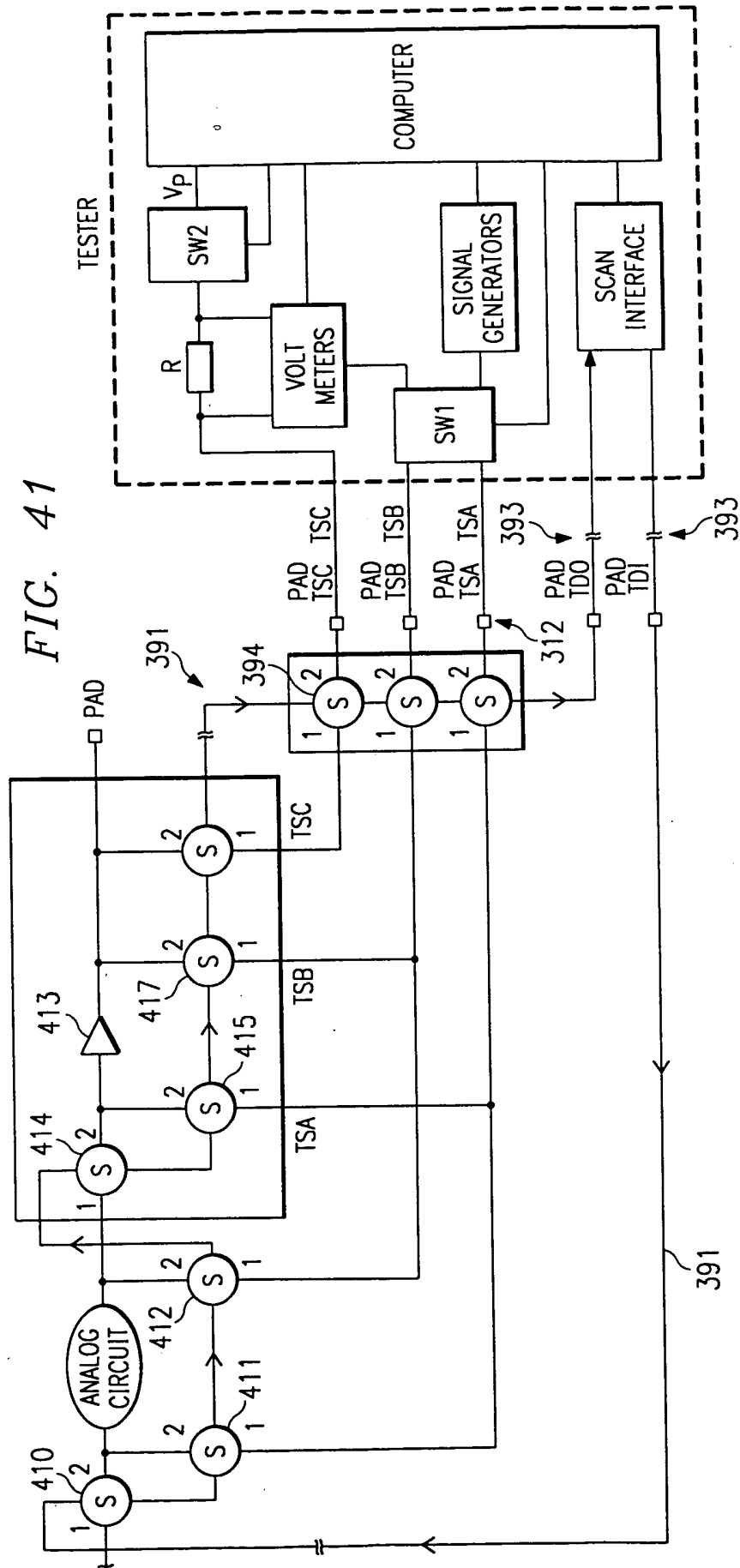


FIG. 42

